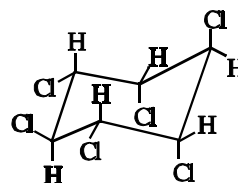


## LINDANE (ALL ISOMERS)

Lindane (all isomers) is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 58-89-9

Molecular Formula:  $C_6H_6Cl_6$



Lindane, the (-)-isomer of hexachlorocyclohexane (see the hexachlorocyclohexanes summary sheet on page 547), is a colorless, crystalline solid with a slightly musty odor. It is soluble in acetone, benzene, chloroform, ether, and ethanol, and insoluble in water (Merck, 1983).

### Physical Properties of Lindane

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#### Synonyms:

1,2,3,4,5,6-hexachlorocyclohexane; (-)-HCH; (-)-benzene hexachloride; gamma benzene hexachloride; gamma hexachlor; ENT 7796; Aparasin; Aphtiria; (-)-BHC; Gammalin; Gamene; Gamiso; Gammexane; Gexane; Jacutin; Kwell; Lindafor; Lindatox; Lorexane; Quellada; Streunex; Tri-6; Viton

Molecular Weight:	290.85
Boiling Point:	323.4 °C
Melting Point:	112.5 °C
Vapor Pressure:	$5.57 \times 10^{-5}$ mm Hg at 25 °C
Log Octanol/Water Partition Coefficient:	3.61
Water Solubility:	7.3 mg/l
Conversion Factor:	1 ppm = 11.89 mg/m <sup>3</sup>

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(Howard, 1990; HSDB, 1991; Merck, 1983)

## SOURCES AND EMISSIONS

### A. Sources

Lindane is registered as an insecticide/acaricide. It is used for the control of lice, fleas, ticks, and mange in barns and in and around other farm or agricultural structures. It may also be used by professional pet care personnel for control of fleas and ticks on dogs. Agriculturally, lindane is registered for use as a seed treatment for a wide variety of crops to

control moths, beetle and flies, and to deter birds. Lindane may be applied by the home gardener for control of fleas and ticks on dogs and in areas occupied by dogs. It is also used to control boring and leaf mining insects on apples, cherries, peaches, azaleas, rhododendrons, and a variety of shrubs and trees. It may be applied as a foliar spray or as a soil drench under these plants (DPR 1996).

The licensing and regulation of pesticides for sale and use in California are the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of lindane has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal uses of this compound, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

#### B. Emissions

The total emissions of hexachlorocyclohexanes, including lindane, from stationary sources in California are estimated to be at least 890 pounds per year based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

#### C. Natural Occurrence

No information about the natural occurrence of lindane was found in the readily-available literature.

### **AMBIENT CONCENTRATIONS**

No Air Resources Board data exist for ambient measurements of lindane. However, the United States Environmental Protection Agency (U.S. EPA) compiled data from a rural location in Texas. This data reported a mean ambient concentration for lindane of 0.23 nanograms per cubic meter (ng/m<sup>3</sup>) with a range of 0.01 to 1.6 ng/m<sup>3</sup> from 1979-80 (U.S. EPA, 1993a).

### **INDOOR SOURCES AND CONCENTRATIONS**

In a U.S. EPA non-occupational pesticide exposure study, 32 household pesticides were measured in homes in three cities over several seasons from 1986 to 1988 (Immerman and Schaum, 1990). The indoor concentrations of lindane isomers were generally low. The mean indoor concentrations for homes in Jacksonville, Florida over three seasons ranged from 1.1 to 20.2 ng/m<sup>3</sup>. The mean indoor concentrations for homes in Springfield/Chicopee, Massachusetts over two seasons ranged from below 0.05 to 9.5 ng/m<sup>3</sup>. In comparison, outdoor concentrations were usually below 0.05 ng/m<sup>3</sup> (U.S. EPA, 1990a).

## ATMOSPHERIC PERSISTENCE

Lindane exists in the atmosphere almost entirely in the gas phase. The dominant atmospheric loss process for lindane is expected to be by the reaction with the hydroxyl (OH) radical. Based on this reaction, and the rate constant for the reaction with the OH radical (Kwok and Atkinson, 1995), the atmospheric half-life and lifetime of lindane is estimated to be about 17 days and 25 days, respectively. Air to water exchange to (and from) the oceans is also important for hexachlorocyclohexanes [of which lindane is an isomer] (Hale and Bidleman, 1995).

## AB 2588 RISK ASSESSMENT INFORMATION

Since no emissions of lindane from stationary sources in California have been reported under the AB 2588 program, it was not listed in any of the risk assessments reviewed by the Office of Environmental Health Hazard Assessment.

## HEALTH EFFECTS

Probable routes of human exposure to lindane are inhalation and dermal absorption.

**Non-Cancer:** Lindane is a central nervous system stimulant and convulsant. Acute inhalation exposure to lindane vapors in humans has resulted in irritation of the eyes and respiratory tract, severe headache, nausea, anemia, and elevated itchy patches of skin. Chronic inhalation exposure to lindane in humans has been associated with effects on the liver, blood, and nervous, cardiovascular, and immune systems (U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 1 microgram per cubic meter ( $\text{Fg}/\text{m}^3$ ) is listed for lindane in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoints considered for chronic toxicity were the kidney, gastrointestinal tract, and liver (CAPCOA, 1993). The Reference Concentration (RfC) is under review by the U.S. EPA, and an oral Reference Dose (RfD) of  $3 \times 10^{-4}$  milligrams per kilogram per day has been set, based on liver and kidney effects in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in chronic, non-cancer effects (U.S. EPA, 1994a).

Limited information is available regarding adverse reproductive and developmental effects of lindane in humans. Adverse effects found in studies on test animals included decreased sperm count, increased testicular weight, and disruption of spermatogenesis following oral exposure to lindane (U.S. EPA, 1994a).

Cancer: No studies are available concerning carcinogenic effects in humans or animals following inhalation exposure to lindane. Lindane has been reported to cause liver cancer in rats and mice exposed orally. The U.S. EPA has classified lindane in Group B2/C: Possible human carcinogen (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified lindane in Group 2B: Possible human carcinogen, based on limited animal evidence (IARC, 1987a).

The State of California has determined under Proposition 65 that lindane is a carcinogen (CCR, 1997). The inhalation potency factor that has been used as a basis for regulatory action in California is  $3.1 \times 10^{-4}$  (microgram per cubic meter)<sup>-1</sup> (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 Fg/m<sup>3</sup> of lindane is estimated to be no greater than 310 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 1.1 (milligram per kilogram per day)<sup>-1</sup> (OEHHA, 1994).